CLAIMS

What is Claimed is:

1. A tip structure for a contact element, comprising

a pad;

a contact tip disposed on a surface of the pad and having a distal end protruding above the surface of the pad;

an alignment mark fixed relative to the pad and spaced apart from the contact tip.

2. The tip structure according to Claim 1, wherein the alignment mark is recessed below the surface of the pad.

3. The tip structure according to Claim 1, wherein the alignment mark protrudes above the surface of the pad.

4. The tip structure according to Claim 1, wherein the alignment mark comprises a shape selected from a pyramid, an elongated pyramid, a cross, a circle, a square, a triangle, and parallel lines.

5. The tip structure according to Claim 1, wherein the alignment mark is disposed on the pad entirely substantially below the distal end of the contact tip.

6. A contactor for contacting a semiconductor device, the contactor comprising:

a plurality of contact structures disposed on a substrate and presenting a plurality of contact tips each for contacting a terminal of the semiconductor device;

means for aligning each of the plurality of contact tips with a terminal of the semiconductor device.

7. The contactor according to Claim 6, wherein the means for aligning comprises a plurality of alignment marks on at least selected ones of the plurality of microelectronic contact structures and spaced apart from the plurality of contact tips.

8. A contactor for contacting a semiconductor device in wafer form, the contactor comprising:

a plurality of contacts disposed on a substrate to present a plurality of contact tips having their distal tips in a plane substantially parallel to the substantially planar surface; and

a plurality of alignment marks disposed on the contactor substantially below the plane wherein the distal tips of the contact tips are disposed.

9. The contactor according to Claim 8, wherein at least selected ones of the plurality of contacts further comprise a tip structure, the tip structure comprising a pad, a contact tip attached to the pad, and at least one of the plurality of alignment marks attached to the pad.

10. The contactor according to Claim 9, wherein the at least one of the plurality of alignment marks is recessed below a surface of the pad.

11. The contactor according to Claim 9, wherein the at least one of the plurality of alignment marks is raised above the surface of the pad.

12. The contactor according to Claim 8, wherein at least selected ones of the plurality of contacts further comprise a tip structure, the tip structure comprising a first pad, and a contact tip attached to the first pad, and a second pad in substantially the same plane as the first pad, the second pad comprising at least one of the plurality of alignment marks.

13. The contactor according to Claim 8, further comprising a plurality of raised platforms disposed on the surface of the substrate, each of the plurality of raised platforms comprising at least one of the plurality of alignment marks attached thereto.

14. The contactor according to Claim 13, wherein each of the plurality of raised platforms further comprises a pad attached thereto, and wherein the at least one of the plurality of alignment marks is recessed below a surface of the pad.

15. A method for forming a tip structure for a microelectronic contact, the tip structure comprising an alignment mark and a contact tip, said method comprising the steps of:

forming the contact tip and the alignment mark on a sacrificial substrate;

transferring the contact tip and the alignment mark to a component of a microelectronic contact; and

removing the sacrificial substrate after said transferring step.

16. The method according to Claim 15, further comprising forming the contact tip and the alignment mark by etching the sacrificial substrate through a patterned resist layer to form depressions therein, and depositing a material in the depressions.

17. The method according to Claim 16, further comprising forming a pad attached to each of the contact tip and the alignment mark by depositing a material in an opening in a patterned sacrificial layer on the sacrificial substrate, wherein the opening is positioned over the depressions.

18. The method according to Claim 15, wherein said forming step further comprises forming the contact tip by etching the sacrificial substrate through a patterned resist layer to form a depression.

19. The method according to Claim 18, further comprising depositing a sacrificial layer on the sacrificial substrate after said forming step, patterning the sacrificial layer to define a first opening therein positioned over the depression, and depositing a material in the first opening to form a pad attached to the contact tip.

20. The method according to Claim 19, further comprising patterning the sacrificial layer to define at least one second opening, and depositing a material in the second opening to form the alignment mark adjacent to and separate from the pad, the alignment mark having a thickness substantially equal to the pad.

21. The method according to Claim 20, further comprising providing the alignment mark with at least one depression in a surface thereof by defining the at least one second opening over a protrusion on the sacrificial substrate.

22. The method according to Claim 21, further comprising forming the protrusion prior to said forming the contact tip step by depositing a resist layer on the sacrificial substrate, removing the resist layer except in a location where the protrusion is to be formed, etching the sacrificial substrate to form the protrusion, and removing the resist layer.

23. A method for forming a contactor having a plurality of microelectronic contacts and a plurality of alignment marks, said method comprising the steps of:

providing a contactor substrate having a plurality of microelectronic contacts thereon;

forming the plurality of contact tips and the plurality of alignment marks on a sacrificial substrate;

transferring the plurality of contact tips and the plurality of alignment marks to the plurality of microelectronic contacts; and

removing the sacrificial substrate after said transferring step.

24. The method according to Claim 23, further comprising forming the plurality of contact tips and the plurality of alignment marks by etching the sacrificial substrate through a patterned resist layer to form depressions therein, and depositing a material in the depressions.

25. The method according to Claim 24, further comprising forming a plurality of pads, one of the plurality of pads attached to each of the plurality of contact tips and to each of the plurality of alignment marks, by depositing a material in a plurality of openings in a patterned sacrificial layer on the sacrificial substrate, wherein each of the plurality of openings is positioned over at least one of the depressions.

26. The method according to Claim 23, wherein said forming step further comprises forming the plurality of contact tips by etching the sacrificial substrate through a patterned resist layer to form a plurality of depressions.

27. The method according to Claim 26, further comprising depositing a sacrificial layer on the sacrificial substrate after said forming step, patterning the sacrificial layer to define a first plurality of openings therein each positioned over one of the plurality of depressions, and depositing a material in the first plurality of openings to form a plurality of pads each attached to one of the plurality of contact tips.

28. The method according to Claim 27, further comprising patterning the sacrificial layer to define a second plurality of openings, and depositing a material in the second plurality of openings to form the plurality of alignment marks adjacent to and separate from the plurality of pads, the plurality of alignment marks having a thickness substantially equal to the plurality of pads.

29. The method according to Claim 28, further comprising providing at least selected ones of the plurality of alignment marks with at least one depression in a surface thereof by defining each of at least selected ones of the second plurality of openings over at least one of a plurality of protrusions on the sacrificial substrate.

30. The method according to Claim 29, further comprising forming the plurality of protrusions prior to said forming the plurality of contact tips step by depositing a resist layer on the sacrificial substrate, removing the resist layer except where ones of the plurality of protrusions are to be formed, etching the sacrificial substrate to form the plurality of protrusions, and removing the resist layer.

31. A method for forming a microelectronic contact structure, comprising an alignment mark and a contact tip, said method comprising the steps of:

forming a microelectronic contact structure comprising a contact tip attached to a supporting structure; and

forming an alignment mark on the supporting structure a defined offset distance away from the contact tip.

32. The method according to Claim 31, wherein the second forming step further comprises forming the alignment mark using a laser.

33. The method according to Claim 31, wherein the second forming step further comprises forming the alignment mark using a ion-beam assisted metal deposition.

34. The method according to Claim 31, further comprising recording coordinates of the defined offset distance relative to the contact tip.

35. The method according to Claim 31, wherein said first forming step further comprises forming the contact tip on a sacrificial substrate, transferring the contact tip to the supporting structure, and removing the sacrificial substrate after said transferring step.

36. The method according to Claim 31, wherein said second forming step further comprises forming the alignment mark on a sacrificial substrate, transferring the alignment mark to the supporting structure, and removing the sacrificial substrate after said transferring step.

37. The method according to Claim 36, wherein said first forming step further comprises forming the contact tip on the sacrificial substrate, transferring the contact tip to the supporting structure, and removing the sacrificial substrate after said transferring step.

38. A method for aligning and contacting corresponding arrays of microelectronic contact elements comprising a first array and a second array to achieve contact between corresponding contact elements of the first array and of the second array, wherein the contact elements of the first array comprise a plurality of contact tips and a plurality of alignment features, and selected ones of the contact elements of the first array each further comprises an alignment feature spaced apart from a contact tip, the method comprising:

determining coordinates of the plurality of alignment features relative to selected ones of the plurality of contact tips of the first array;

maintaining the second array in a known position;

determining a determined position of the first array relative to the second array by transforming measured positions of the plurality of alignment features relative to the second array using the coordinates;

positioning the first array relative to the second array using the determined position to achieve contact between corresponding contact elements of the first array and of the second array.

39. The method of Claim 38, further comprising creating a data file of the coordinates and providing the data file to a robotic system for aligning the first array with the second array.

40. The method of Claim 38, further comprising measuring the measured positions of the plurality of alignment features using a machine vision system.

41. The method of Claim 38, further comprising continuously repeating said second determining step during said positioning step.

42. The method of Claim 38, wherein the plurality of contact tips of the first array are in a substantially fixed relationship to the first array during the first and second determining steps.

43. A method for aligning an array of contact elements on a contactor with corresponding contact elements on a device, the method comprising:

forming an alignment feature on at least one of the contact elements on the contactor, wherein the alignment feature is spaced apart from a contact tip of the at least one of the contact elements;

determining a position of the alignment feature relative to the contact tip; and

aligning the contactor with the device using the position of the alignment feature.